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FRONTLINE DEMONSTRATION OF WALKING TYPE SELF-PROPELLED REAPER CUM BINDER IN JORHAT DISTRICT

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Abstract

Globally, the rank of India in the production of rice is second in the world after China. Rice is the most significant crop in Assam, which accounts for 2.54 million hectares of the overall planted area of 4.16 million ha. Early harvesting could open up opportunities for extra revenues through farming of short duration vegetable crops in the gap between two major crops i.e. paddy and wheat. The use of mechanized power for agriculture purpose reduces not just the hardship faced by the farmers under traditional manual practices but also speeds up agricultural processes, saves cost and enhances agricultural productivity. Various types of paddy harvesters are already available in market which are bulky and are costly. Considering the topographical scenario of paddy farms in Jorhat district of Assam, the performance of self-propelled reaper cum binder was evaluated. The cutting width was found to be 1828.8mm, with fuel consumption 3-4.5 l/ha, and the working efficiency was found to be 4046.86 m^2/h. The Effective working width is 620mm, effective field capacity as 0.0823ha/h and the field efficiency as 99.15%. The machine was found suitable to be used in Assam condition considering the moisture present during the harvesting of paddy.

Keywords: Harvesting, Paddy, Harvester, Reaper, Reaper cum Binder.

1. Introduction

Paddy is cultivated globally being one of the most important cereal crops worldwide. USDA's Global rice production in 2023/24 is projected at a record 520.9 million tons (milled basis), up 173,000 tons. Ninety six (96%) of the Assam's entire production of cereal grains comes from rice. Over the ages, Indian farmers have mainly used human and animated power and traditional methods passed onto them by their ancestors for cultivation of various agricultural crops. Wheat and Rice are the two most important staple foods for the people of the Asian countries. Harvesting consumes as much as 20-30 per cent of manual labour requirement. When the crop is physiologically matured, the harvesting process begins to get maximum recovery of grains. Harvesting should be done at an appropriate stage to minimize losses, and to increase the yield. Manual harvesting of field crops is considered as labour intensive operation and takes from cutting to bundle making about 185-340 man-h/ha for wheat or paddy crops (Michael and Ojha, 1987).

The labour shortage during harvesting resulted in delayed harvest and consequent field grain losses. Mechanization of harvesting is an alternative solution. Mechanized agriculture is the process of using agriculture machinery to mechanize the work of agriculture, greatly increasing farm worker's productivity.

The use of mechanized power for agriculture purpose reduces not just the hardship faced by the farmers under traditional manual practices but also speeds up agricultural processes, saves cost and enhances agricultural productivity. The objective of this study is to practice front line demonstration of self-propelled walking type reaper cum binder at various locations of Jorhat districts of Assam and to evaluate the performance of the reaper cum binder in terms of working efficiency, effective field capacity and field efficiency.

2. Methods and Methodology:

Three different locations under Jorhat districts i.e. at farmer field Teok, Golaghat and ICR farm, AAU, Jorhat were taken into consideration and personal interviews were taken during the trails and demonstration of the self-propelled reaper. The most appropriate data were collected from ICR farm of Assam Agricultural University, Jorhat during the financial year 2023-24.

The details of materials used, experimental methodology and measurement techniques adopted during the course of demonstration are presented as follows.

Specification of Self-propelled Reaper cum binder:

The Self-propelled walking type reaper cum binder was developed by Khedut Agro Engineering Private Limited, Rajkot, Gujarat. It is an air cooled diesel engine.

2.1Machine Parameters:

While doing the research trial, the following research trail was conducted.

2.1.1 Forward Speed

Forward speed was measured by dividing the distance by time required to travel that distance.

$$Forward\ Speed, s = \frac{Distance\ travelled\ by\ the\ Reaper\ cum\ binder(m)}{time\ (s)}$$

Where, d = distance travel (m), t = time (s)

2.1. 2 Theoretical Field Capacity

Theoretical field capacity (T.F.C) was measured based on the forward speed and the cutting width of Reaper cum binder.

$$Theoretical\ Field\ Capacity, T.F.C = \frac{Forward\ Speed\ (\frac{m}{s})}{cutting\ width\ (m)}$$

Where, s= forward speed of travel, km/hr, w=total width covered, m, c = constant, 10.

2.1.3 Effective Field Capacity

The Effective field capacity is the actual average rate of coverage by the machine, based upon the total field time. The area covered divided by the total time is the actual field capacity.

$$E.F.C\ \left(\frac{ha}{h}\right) = \frac{Actual\ Rate\ of\ Coverage}{Total\ Field\ Time}, \frac{ha}{h}.$$

2.1.4. Field Efficiency (%)

The field efficiency was determined by the ratio of actual field capacity (AFC) to the theoretical field capacity (TFC).

$$Field\ Efficiency, \% = \frac{E.F.C}{T.F.C} \times 100$$

2.2 Cost Calculation:

The fixed cost and operating cost of the self-propelled reaper cum binder were taken into account. Fixed cost includes depreciation, interest on investment, shelter, taxes and insurance. Depreciation costs were evaluated by straight line method as described by Nipa (2016). Variable cost includes fuel, lubricant, repairs and maintenance cost and labour cost.

Repair and maintenance cost was taken as 5% of the purchase price. The fuel cost (diesel) was considered as Rs.93.00 per litre while lubricant cost was taken as 30% of the fuel cost. Useful life of Reaper binder was considered 5 years.

The machine salvage value was considered as 10% of purchase price or capital investment.

2. 2.1 Input cost

The input cost of operation of Reaper binder was determined. The input cost is actually a sum of fixed cost and operating cost.

2.2.2 Fixed cost

The fixed cost is the cost which is involved irrespective of whether the machine is used or not. These costs include; depreciation cost, interest on investment and taxes, shelter and insurance.

2.2.3 Depreciation

Depreciation is the reduction in value of a machine with the passage of time. It is the loss of value of a machine with the passing of time. Its formula is as follows:

$$D = \frac{C - S}{L \times H}$$

Where,

D = depreciation per hour (Rs./hr)

C = capital investment (Rs.)

S = salvage value, 10% of capital investment

H = number of working hours per year and

L = Life of the machine in years.

2.2.4 Interest on Investment

$$I = \frac{C + S}{2} \times \frac{i}{H}$$

Where, I = interest on investment per hour (Rs./hr)

i = % rate of interest per hour

2.2.5 Shelter

Shelter cost was calculated on the basis of the prevailing rates of the locality but roughly speaking, the shelter cost may be taken as 1% of the initial cost of the machine per year.

Shelter, S = 1 % of the initial cost of the machine. (i.e. C) (Rs/h)

2.2.6 Taxes

Taxes were calculated on the basis of the actual taxes paid per year but roughly speaking, it may be taken as 1% of the initial cost of the machine per year.

Taxes, T = 1 % of the initial cost of the machine. (i.e. C) (Rs/h).

2.2.7 Insurance

Insurance charge is taken on the basis of the actual payment to the insurance company but roughly speaking, it may be taken as 1% of the initial cost of the machine per year.

$$Insurance\ cost, I = 1\%\ of\ the\ insurance\ cost\ of\ the\ machine \text{ (Rs/h)}$$

Thus, Total fixed cost is given by the formula.

$$Total\ fixed\ cost\left(\frac{Rs}{h}\right) = D + I + S + T + I$$

2.3 Variable cost

The variable cost of the machine was calculated using the fuel cost, oil cost or lubrication cost, repair and maintenance cost and labour cost (i.e. wages). It is also known as operating cost.

2.3.1 Fuel cost

Fuel cost is calculated on the basis of actual fuel consumption in the machine. It is generally determined by using the formula as follows:

$$Fuel\ Cos,F\ \left(\frac{Rs}{h}\right) = Fuel\ consumption\ (\frac{l}{h}) \times Price(\frac{Rs}{l})$$

2.3.2 Oil Cost/ Cost for lubrication

Charges for lubricants should be calculated on the actual consumption, but roughly speaking the lubricants cost varies between 30 to 35% of the fuel cost.

2.3.3 Repair and maintenance cost

Repairs and maintenance cost was taken 5% of the initial cost of the machine per year.
Repair and Maintenance cost, R&M (Rs/h)
= 5% of capital cost per year, C.

2.3.4 Labour cost (i.e. wage of labour)

Labour cost is calculated on the basis of actual wage of the worker.

$$\text{Labour cost} = \frac{wage\ of\ labour}{Time\ for\ which\ the\ labour\ is\ hired}$$

Thus, Total variable cost is given by the formula:-
Total variable cost (Rs/h) = F + O + R&M + L
Total input cost = Total fixed cost (Rs/h) + Total operating cost (Rs/h)

2.3.5 Labour requirement

It may be defined as number of workers and man-hour required for harvesting one hectare of land.

3. Results and Discussion

Due to several drawbacks of the traditional harvesting methods, attempts were made to introduce suitable mechanical device to check its feasibility and excellence than manual harvesting.

3.1 Field performance evaluation

The field performances of different types of Reaper binder were evaluated.

3.2 Location: The experiment was done in ICR, Farm, AAU, Jorhat. The soil texture was clayey loamy type of soil. The experimentation was done at around 9:30 am till 5:00pm.

3.3. Design Layout:

The self propelled reaper cum binder was made to harvest the standing paddy stalks in anti-clockwise direction.

Firstly after starting the machine, it was found it takes time to get heat up.

The design is made so as to cover the entire field within a day.

Due to presence of ellipsoidal damaged area due to wind turbulence, the machine faced difficulty in covering up the area in a single go and was stuck in all field operation.

3.4 Measuring Machine parameters

The machine parameters such as power source, type, working efficiency, dimension, weight, engine, cutting weight, minimum cutting height and crop placing of the individual machines were evaluated.

Table 3.2 Technical specification of equipments used during FLD on Walking Type Self-Propelled Reaper cum Binder in comparison with other harvester available in market

Make	Bharat	VST Shakti	Kisan Kraft (attachment to KK-srt-910E rotary weeder)	Kisan Kraft shoulder mounted reaper	Khedut Walking Type Self-Propelled Reaper cum Binder
Power Source (hp)	Self propelled rated power 3.4	Self propelled, rated power 4	Self propelled rated power 8.5	Hand Operated with 1.9 hp engine	Self Propelled walking Type 5.5 HP
Type	Walking type	Walking type	Walking type	Baffle type	Walking type
Working efficiency (Sq m/h)	2400-2700	2400-2700	2400	-	4046.86 m^2/h
Dimension LWH, mm	2200*1600*1100	2200*1600*1100	-	-	
Weight, Kg	200	200	-		
Engine	Model JD170F, Single cylinder air cooled diesel engine Power (hp/rpm):4.0/2600 Fuel tank capacity: 4 l Starting: hand cranking	Z170F, Single Cylinder air Cooled Diesel Engine Power (hp/rpm): 4.0/2600 Fuel tank capacity: 4 l Starting: hand cranking	4 stroke diesel. Power (hp/rpm): 8.5/3600	1.9 hp, 6500 rpm, 7.5 kg weight, 2 stroke	5.5 HP, 620 MM Cutting dimension, Diesel engine, 20 - 80 mm cutting capacity, 6 feet cutter bar width.
Cutting	Cutting type vertical	Cutting type vertical	Cutting type vertical	-	Cutting type vertical
Cutting width, mm	1200	1200	1250	500	1828.8mm
Min cutting height, mm	Greater than equal to 50	Greater than equal to 50	Greater than equal to 50	-	Greater than equal to 50
Crop placing	Right side of m/c	Right side of m/c	Right side of m/c		Right side of m/c

Comparative evaluation of Vertical Conveyor reaper, Kisan Kraft (attachment to kk-srt-910), Kisan Kraft shoulder mounted reaper and Kedut self-propelled walking type reaper cum binder in respect to that of effective working width (mm) and Effective field capacity (ha/h) was done.

The effective working width varies directly with that of effective field capacity for Vertical Conveyor reaper, Kisan Kraft (attachment to kk-srt-910), Kisan Kraft shoulder mounted reaper and Kedut self-propelled walking type reaper cum binder respectively.

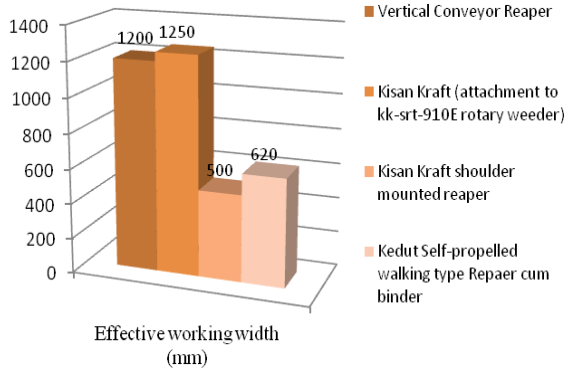

Plate 3.3: Effect of the working width of different kind of reaper cum binder

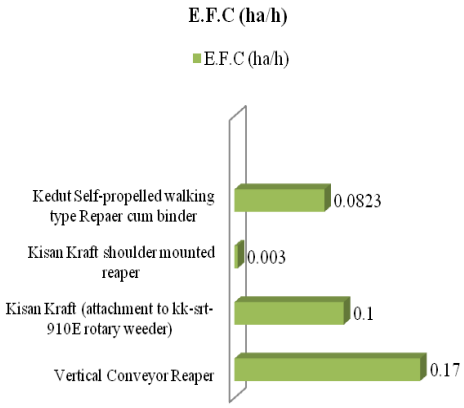

Plate 3.4: Effect of Effective field capacity of different kind of reaper cum binder

Plate 3.5: Measurement of left-out stubble height

4. Conclusion

Walk behind Self-propelled Reaper cum Binder was subjected to FLD by the author and team of AICRP on Farm Implements and Machinery, Jorhat Centre during 2023. The results were encouraging. The actual value of field capacity was 0.0823 ha/h. No visible shattering loss was observed. The observed fuel consumption was around 3-4.5 l. This machine performs extremely well under typical dry field condition with erect crop. However, the tying as well as binding rope often breaks off during operations which ultimately hamper the overall threshing as well as field capacity.

This machine helps in saving of time with prompt bonding action. Are must the taken that without attaching the binding rope machine must not be operated.

Farmers' feedback:

- Time saving
- Farmers friendly
- Good for erect crop
- Can be operated by healthy women if trained.

5. References

Michael, A.M. and Ojha, T.P. (1987). Principles of Agricultural Engineering, 1. ML Jain for Jain Brothers, New Dehli, India.

Dutt, P. and Prasad, J. (2002). Modification and evaluation of self-propelled reaper for harvesting soybean. AMA. 3:43-46.

Manes, G.S.; Sandhar, N.S.; Bal, A.S. and H.M. Khurana. (2003) Comparative performance of combine harvester. Journals of Agril. Engg. Vol. 27 (1-2): No. 7-14.

Pathak, S. V., Pawar, C.S. and Shirsat, N.A. (2008) Performance evaluation of combine harvester and combination of self-propelled vertical conveyor reaper with thresher for wheat harvesting, Ag. update, Feb-July (2008), Vol. 3 (1&3): 123-126.

Manjunatha, M. V., Masthana, B. G., Reddy, S. D., Joshi, and V. R. (2009). Field performance evaluation on vertical conveyor rice reaper, Karnataka J. Agric. Sci, 22(1): 140-142

Nipa, J. F. (2016). Study on performance evaluation of selfpropelled reaper. In Proceedings of the International Conference on Industrial Engineering and Operations Management, Kuala Lumpur, Malaysia.

Anurag Patel, Rajkishor Singh, Prabhakar Shukla and Moses, S.C. (2018). Performance Evaluation of Self Propelled Reaper Binder for Harvesting of Wheat Crop. Int.J.Curr.Microbiol.App.Sci. 7(12): 896- 906. doi: https://doi.org/10.20546/ijcmas.2018.712.112.

Singh, Jitendra (2018). Field evaluation of self propelled reaper cum binder through front line demonstration in wheat crop in Indore district of Madhya Pradesh. Internat. J. Agric. Engg., 11(2) : 359-363.

Himanshu Rao, J. and Balveer Singh Meena (2019). Performance and Cost Economics Evaluation of Different Types of Reaper Binder for Harvesting of Wheat in Satna District of Madhya Pradesh, India. Int.J.Curr.Microbiol.App.Sci. 8(10): 2115-2124.